DOI 10.1007/s10812-018-0703-8
Journal of Applied Spectroscopy, Vol. 85, No. 4, September, 2018 (Russian Original Vol. 85, No. 4, July–August, 2018)

INFORMATION TRANSFORMATION ALGORITHMS IN ECHO-HOLOGRAPHY

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The filtering of optical signals and the transformation of information using stimulated echo-holography is examined in the case where it is excited by an information-carrying object laser pulse and a pulse that serves as a frequency filter. It is shown that the shape of the response of the stimulated echo hologram depends on the duration, amplitude, area, and temporal structure of the exciting pulses. This can be used for logical operations with signals.

Keywords: *echo hologram, information recording, object laser pulse, temporal form of response, frequency filter.*

Introduction. Optical data processing is one of the three methods for signal processing currently in use: analog, digital, and optical. The greatest advances in optical signal processing began in the 1960′s with the invention of lasers. That opened up great possibilities in terms of productivity and speed of processing (especially multichannel) and very simple designs for rather complicated operations. The actual parameters of optical signal processing devices are, however, still far from the theoretical limits. This difference is explained to a great extent by the inadequacies of devices for input of signals into optical processors, i.e., spatial-temporal modulators of light. A major shortcoming of devices for optical signal processing is their narrowspecialization and the lack of significant advances in creating universal or even tunable devices. Thus, at present the three forms of signal processing devices supplement each other, with optical systems providing high capacity, specialized devices that perform a large number of fairly complicated operations of the same kind.

Optical data processing methods are based on the conversion of spatially modulated optical signals in optical devices and systems using the principles of geometric and wave optics. Data processing involves the conversion, analysis, and synthesis of multidimensional functions describing the properties and state of objects in the material world. Optical data processing is carried out in an optical processor — an analog optical or electro-optical device — which changes, in a certain way, the amplitude and phase of a spatially modulated optical signal containing information about an object.

The major advantages of optical data processing systems are: high information capacity, multichannel operation (a large number of channels processed in parallel), high speed, and multifunctionality (Fourier, Fresnel, Hilbert, etc., integral transformations, calculation of two-dimensional convolutions, correlations, etc.). Optical data processing systems are divided into systems using incoherent and coherent (laser) light sources. Coherent data processing techniques have become most popular in recent years. The areas of practical applications for optical data processing include: mobile image recognition and processing systems, on-board orientation and aiming systems in military technology, devices for extracting weak signals against passive and active noise backgrounds, synthetic aperture radar stations, large-capacity computing machinery, metrology, robot technology, and nondestructive testing.

Photon echo processors (PEP), which are in the class of multifunctional analog devices, are of special interest. Because of the presence of control signals, their pulse characteristic can be programmed in real time and various forms of operation can be obtained, ranging from simple memory to integral transformations. Here, as with the optical processor, a PEP can operate in temporal, spatial, and spatial-temporal domains, with coherent or incoherent data processing [1]. Thus, in principle, PEP offer a fairly rich set of instrumentation for processing of signals and images by analog, as well as digital, methods, and make it possible to combine both in a single device.

The problem of retranscribing data has been regarded as a bottleneck for PEP: a new transcription can be carried out after establishment of thermal equilibrium ($\sim 3T_1$), which is determined by the longitudinal relaxation time T_1, i.e.,

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